

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Image Problems Mailbox.**

THIS PAGE BLANK (USPTO)



The
Patent
Office

PCT/GB 08/000472
14 FEBRUARY 2000

**PRIORITY
DOCUMENT**
SUBMITTED OR TRANSMITTED IN
COMPLIANCE WITH RULE 17.1(a) OR (b)

DIRECTOR IN PEOPLE	
REC'D 08 MAR 2000	
The Patent Office	
Compt House	PCT
Cardiff Road	
Newport	
South Wales	
NP10 8QQ	

GB 00/472

09/913426

4
I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

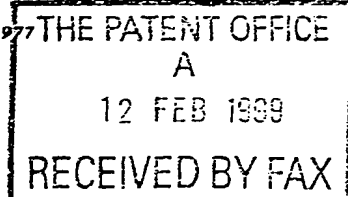
In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed *Andrew Gersey*
Dated 29 February 2000

THIS PAGE BLANK (USPTO)

Patents Act 1977
(Rule 16)

The Patent Office

1252599 5424916-1 000354
501/7700 0.00 - 9903148.6

Request for grant of a patent

(see the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

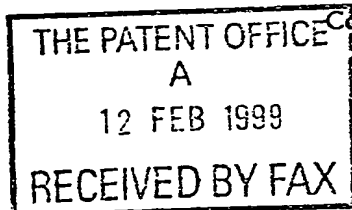
The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1.	Your reference	DE/J088339PGB		
2.	P. /	9903148.6		
		12 FEB 1999		
3.	Full name, address and postcode of the or of each applicant (<i>underline all surnames</i>)	HENROB LIMITED ABER PARK FLINT FLINTSHIRE CH6 5EX		
	Patents ADP number (<i>if you know it</i>)	CH6 5EX		
	If the applicant is a corporate body, give the country/state of its incorporation	UNITED KINGDOM		
4.	Title of the invention	FASTENER DELIVERY APPARATUS		
5.	Name of your agent (<i>if you have one</i>)	Marks & Clerk		
	"Address for service" in the United Kingdom to which all correspondence should be sent (<i>including the postcode</i>)	Sussex House 83-85 Mosley Street Manchester M2 3LG		
	Patents ADP number (<i>if you know it</i>)	18004		
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (<i>if you know it</i>) the or each application number	Country	Priority application number (<i>if you know it</i>)	Date of filing (<i>day/month/year</i>)
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing (<i>day/month/year</i>)	
8.	Is a statement of Inventorship and of right to grant of a patent required in support of this request? (<i>Answer 'Yes' if:</i> a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))	YES		

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form.
Do not count copies of the same document



Continuation sheets of this form

Description	8✓
Claim(s)	2✓
Abstract	1✓
Drawing(s)	2✓

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of Inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents
(Please specify)

11. I/We request the grant of a patent on the basis of this application.

Signature *M. Marks* MARKS & CLERK Date 12/02/99

12. Name and daytime telephone number of person to contact in the United Kingdom MR. DAVE EVERY
0161 233 5804

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

- If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.
- Write your answers in capital letters using black ink or you may type them.
- If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- Once you have filled in the form you must remember to sign and date it.
- For details of the fee and ways to pay please contact the Patent Office.

FASTENER DELIVERY APPARATUS

The present invention relates to fastener delivery apparatus and more particularly, but not exclusively to delivery apparatus for transferring rivets from a supply to a setting tool of a riveting machine.

The term "fastener" is used herein to describe rivets, screws, slugs or other types of fastening devices.

It is well known to distribute rivets or other fasteners (e.g. studs, nuts, bolts) between a supply and a setting tool of a riveting machine or setting tooling within a press by conveying them individually in delivery tubes by compressed air propulsion. A delivery tube of this kind typically has an internal passageway that is configured to conform closely to the shape of the fastener. Additional compressed air may be admitted into the tube at one or more locations along the length of the tube by means, for example, of T-junctions, branch tubes, or elbows connected between a supply of compressed air and the delivery tube, to propel the rivets along the length of the tube.

There are several problems associated with compressed air delivery tubes of the kind described above. First, there is a tendency for fasteners to jam in the tube. This renders the tube inoperable until steps have been taken to clear the blockage. It is often desirable to be able to transport a plurality of fasteners at once along a delivery tube but this significantly increases the tendency to jam. Secondly friction between the fasteners and the tubes causes tube wear. Delivery tubes have to be inspected at regular intervals for wear as a worn tube may be susceptible to blockages or slower feed rates causing increased cycle times. Moreover, wear often results in accumulation in the delivery tube of external dirt, dust or moisture or trace particles of the fastener, fastener coating or tube and they may also cause blockages and slower feed rates.

Compressed air pressure normally decreases along the length of the delivery tube owing to losses (such as for example leaks or friction losses). The desired pressure is generally maintained by supplying further air at booster points (in the form of T-junctions and branch tubes etc.) along the length of the tube and/or by increasing the pressure of the compressed air at source. The increase in air pressure and the

addition of booster points increases air turbulence within the tube. If the flow of air is not as smooth as possible there is an increased tendency for fastener jams and the resultant scraping contact can in turn cause wear in the tube. The decreasing air-pressure owing to losses can also cause heavier fasteners to lose momentum so that they fail to reach the end of their journey with sufficient speed unless compressed air booster points are employed.

Existing delivery tubes are often lubricated to ensure that fasteners are transferred at acceptable speeds, and to reduce wear and friction. However, over a period of use the ingress of dirt can result in the tube becoming clogged by a paste comprising the combination of the dirt or trace particles and lubrication oil or moisture.

Known compressed air fastener delivery systems operate at an air pressure of between 5 and 6 bar. This pressure is normally required to ensure sufficient fastener momentum throughout the length of the delivery tube so that it reaches the desired destination despite friction losses or minor obstacles (dirt etc) in the tube, and/or to accommodate air loss through leakages. A further disadvantage is that known systems may require the continuous application of such air pressure at 5-6 bar to maintain effective performance, as opposed to controlled blasts. Moreover, owing to the above limitations, known systems cannot reliably feed fasteners over long distances, the maximum possible tube lengths being typically 8m-15m.

It is an object of the present invention to obviate or mitigate the aforesaid disadvantages and to provide for fastener delivery apparatus that operates at higher transportation speeds, greater distances (typically in excess of 100m) and lower air pressures (and therefore lower air consumption rate and cost) than currently possible without the use of a lubricant.

According to the present invention there is provided a fastener delivery apparatus comprising a fastener delivery tube connected between a supply of fasteners and a setting tool of a fastener machine, the tube having an internal cross-section configured to conform substantially to the size and shape of the fastener to be used and connected to a source of pressurised gas, wherein the source of pressurised gas

has a supply bore with an interior shape and dimension that is substantially equal to an interior dimension and shape of the delivery tube and wherein the supply of fasteners is connected to the delivery tube via a sealable passage that may be sealed so as to prevent leakage of gas from the delivery tube.

By ensuring that the size and shape of the pressurised gas outlet bore and the delivery tube are matched, there is a significant reduction in turbulence of the pressurised gas. This ensures that the flow of gas remains smooth and laminar thereby preventing fasteners from being thrown against walls of the delivery tube and losing momentum as they travel along the tube. Lubrication of the tube is therefore not required and feeding of a plurality of rivets at once becomes feasible. In addition, the sealed passage reduces the leakage of gas from the apparatus. This feature enables the compressed gas to be supplied at significantly lower pressures, such as 2 bar or less, than is currently possible. The profile of the fastener in the tube provides an effective seal and the smooth laminar flow of the gas reduces its contact with the wall of the delivery tube. In reducing the gas pressure required to transport the rivet the running cost of the apparatus is significantly reduced. Moreover, noise pollution is significantly reduced. The use of a sealed passage provides a barrier against the ingress of dirt and ensures that the pressurised gas supply is used efficiently by directing all of the supplied gas towards the fastener.

Such apparatus also achieves consistent, repeatable minimum transport times for each given design of fastener allowing the full process cycle, e.g. feeding and riveting, to be efficiently implemented at as high a rate as possible.

The present invention lies partly in the realisation that the flow rate of the pressurised gas is more important than the gas pressure in transporting fasteners and that it is more efficient to introduce a fastener into the path of a pressurised gas jet rather than to direct the gas towards the fastener in the tube via branch tubes or the like.

The pressure of the pressurised gas is preferably 2 bar or less.

The source of pressurised gas is preferably disposed so that, in use, gas is in coaxial with a longitudinal axis of the tube.

Preferably the sealable passage is sealable by a gate having an internal cross-section that is substantially matched in terms of shape and dimension to the internal cross-section of the delivery tube so as to reduce turbulence or drag to the flow of gas passing it.

The passage is preferably sealed by a transfer gate preferably in the form of a ball valve that is rotatable between a first position in which a aperture in the ball valve is in communication with the supply of fasteners so as to receive at least one fastener and a second position in which the aperture provides a path between the source of pressurised gas and the delivery tube.

Advantageously the delivery tube is of a size such that, in use, there is clearance between the fastener and the tube so as to provide a gas cushion around the fastener. This reduces the friction between the fastener and walls of the delivery tube and also reduces the tendency of the fastener to jam in the tube. These advantages outweigh any reduction of motive force due to air leakage past the fastener.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of fastener delivery apparatus of the present invention;

Figures 2a to 2c show the operation of a fastener transfer gate in transferring a fastener from a supply into a delivery tube;

Figure 3 shows a rivet in a delivery tube of the present invention; and

Figure 4 is a cross-section through a modified embodiment of a fastener transfer gate.

Referring now to the figure 1 of drawings, there is shown apparatus for transferring rivets from a central rivet supply to the nose of a rivet setting machine (neither of which are shown in the drawings).

The apparatus comprises a rivet delivery tube 1 in which rivets 2 are transported individually or in groups between the supply and the nose of the rivet setting machine, a compressed air supply 3 connected to one end of the delivery tube 1 and a rivet transfer gate assembly 4 disposed in close proximity to the compressed

air supply 3. The transfer gate assembly 4 comprises a housing 5 with a first inlet aperture 6 connected to an outlet tube 7 of the compressed air supply 3, a second inlet aperture 8 connected to the end of a feeder tube 9 from the rivet supply and an outlet aperture 10 connected to the delivery tube 1.

The interior of the housing 11, shown in figures 2a to 2c, has a tube portion interconnecting the delivery tube 1 and the outlet tube 7 of the compressed air supply 3. The tube portion incorporates a ball valve assembly 12 comprising a valve seat 13 in which there is disposed a rotatable ball valve 14. The valve seat 13 includes O-ring seals 15 or the like disposed on each side of the ball valve 14.

The ball valve 14 has a central passage 16 and is rotatable, by means of a rotary actuator 17, between a first position in which it is coaxially aligned with the feeder tube 9 and a second position in which it is coaxially aligned with the outlet tube 7 of the compressor supply 3 and the delivery tube 1. In the first position of the ball valve 14 (shown in figure 2a) the rivet 2 is able to enter the ball valve passage 16 of the transfer gate assembly 5 from the feeder tube 9. Rotation of the valve 14 to the second position (shown in figures 2b and 2c) moves the rivet 2 through 90° and seals the feeder tube 9 against communication with the compressed air supply 3. This ensures that the full force of the compressed air (now in communication with the passage 16 in the ball valve 14) is used to propel the rivet 2 into the delivery tube 1 as represented by the arrows in figure 2c.

The apparatus is designed such that there is an annular clearance 18 (shown in figure 3) between the head of the rivet 2 and the walls of the delivery tube 1. This enables some of the compressed air to pass through the clearance 18 and provides an air cushion between the rivet 2 and the tube 1 to reduce the frictional contact therebetween.

The source of compressed air is disposed so that the path of the air is substantially co-axial with the longitudinal axis of the delivery tube so as to minimise turbulence.

The high flow-rate but low pressure of the air ensures that effective use is made of the air for transporting the rivet.

The cross-section of the bore of the compressed air supply outlet tube 7 is designed to match the size and shape of the interior passage of the delivery tube 1 and the ball valve 14. This ensures that the flow of compressed air is smooth and laminar thereby preventing rivets from being thrown against walls of the delivery tube 1 and losing momentum as they travel along the tube 1. Moreover the internal cross section of the ball valve passage 16 is matched in terms of size and shape to the internal cross-section of the delivery tube for the same reasons.

When the ball valve 14 is rotated to allow the rivet 2 to be blown into the delivery tube 1, it serves to seal the feeder tube 9 from the compressed air supply 3 and thus reduces the leakage of air from the apparatus. This feature enables the compressed air to be supplied at significantly lower pressures, such as 2 bar or less, than those that are currently used. The profile of the rivet 2 in the delivery tube 1 provides an effective seal and the smooth laminar flow of the air reduces its contact with wall of the delivery tube 1. In reducing the air pressure required to transport the rivet 2 the cost of the apparatus is significantly reduced. Moreover, noise pollution is significantly reduced.

Figure 4 shows a more detailed embodiment of the transfer gate. The ball valve 14 is mounted in a valve seat 20 defined by a housing body 21 so that it is rotatable in the manner described above. The delivery tube 1, the air supply outlet tube 7 and the fastener feeder tube 9 are all of identical or similar configuration and their ends connect to the transfer gate housing body 21 via interface collars 22a, 22b, 22c which are all of identical design. The interface collars 22a, 22b, 22c are designed to mate with complementary formations on the housing body 21 and, once connected, are sealed thereto by seals 23. Each end of the delivery, air supply outlet and feeder tubes 1, 7, 9 has an annular radially outward extending flange 24a, 24b, 24c that is received inside the respective collar 22a, 22b, 22c with an axial clearance 25. Springs 26 are disposed parallel to the axis of the respective tube 1, 7, 9 between the collar 22a, b, c and the flange 24a, b, c and serve to bias the tubes 1, 7, 9 towards the ball valve 14.

When the passage 16 in the ball valve 14 is coaxial with a particular tube 1, 7, 9 the respective spring 26 biases the tube axially into sealing engagement with the ball valve 14, so that air loss at the junction between the tube 1, 7, 9 and ball valve 14 is significantly reduced or eliminated entirely. The axial clearance enables the tube 1, 7, 9 to deflect axially out of the housing 21 slightly as the ball valve 14 is rotated and comes into contact with it and the springs 26 ensure that the tube 1, 7, 9 move axially back into full sealing engagement when aligned with the ball valve passage 16. Thus the ball valve 14 acts as a cam against the ends of the tubes 1, 7, 9.

The exterior of the tubes 1, 7, 9, and/or collars may be provided with any form of protuberance or other projecting formation that is complementary to a groove or recess in the housing body 21 so as to ensure correct orientation and location of the tube in the housing body. The connection between the tube 1, 7, 9 and housing body 21 is also preferably designed to be a quick-connect coupling, such as, for example, a snap-fit.

In a modified embodiment (not shown) there may be provided an additional source of compressed air or other pressurised gas that is directed over the rivet or rivets in the transfer gate so that the rivet(s) is cleaned of surface dust or debris etc.

The use of a sealed transfer gate provides a barrier against the ingress of dirt and ensures that the compressed air supply is used efficiently by directing all of the supplied air towards the fastener. It also enables a plurality of fasteners to be delivered at once with reduced risk of jamming.

It will be appreciated that numerous modifications to the above described design may be made without departing from the scope of the invention as defined in the appended claims. For example, the transfer gate need not be in the form of a ball valve but may take other forms and may be operated automatically provided that the compressed air supply is sealed from the feeder tube when the rivet is being propelled into and along the delivery tube.

It is to be understood that although the exemplary fastener delivery apparatus has a compressed air supply, and that any suitable supply of pressurised gas can be used. Moreover, although the rivet is shown in figure 3 as being transported axially,

12 FEB. 1999 16:36

M & CLERK M/C 0161 236 5845

P.12

K-117

Job-453

NO. 484

P.12/17

8

the principles described above apply equally to a rivet that it transported sideways through a tube having an internal profile that is T-shaped.

CLAIMS

1. Fastener delivery apparatus comprising a fastener delivery tube connected between a supply of fasteners and a setting tool of a fastener machine, the tube being of a cross-section having an internal cross-section configured to confirm substantially to the size and shape of the fastener to be used and connected to a source of pressurised gas, wherein the source of pressurised gas has a supply bore with an interior shape and dimension that is substantially equal to an interior dimension and shape of the delivery tube and wherein the supply of fasteners is connected to the delivery tube via a sealable passage that may be sealed so as to prevent leakage of gas from the delivery tube.
2. Fastener delivery apparatus according to claim 1, wherein the pressure of the pressurised gas is 2 bar or less.
3. Fastener delivery apparatus according to claim 1 or 2, wherein source of pressurised gas is disposed so that, in use, the path of the gas is coaxial with a longitudinal axis of the tube.
4. Fastener delivery apparatus according to claim 1, 2 or 3 wherein the sealable passage is sealable by a gate having an internal cross-section that is substantially matched in terms of shape and dimension to the internal cross-section of the delivery tube so as to reduce turbulence or drag to the flow of gas passing it.

5. Fastener delivery apparatus according to any preceding claim, wherein the sealable passage is in the form of a ball valve that is rotatable between a first position in which an aperture in the valve is in communication with the supply of fasteners so as to receive at least one fastener and a second position in which the aperture provides communication between the source of pressurised gas and the delivery tube.
6. Fastener delivery apparatus according to any preceding claim, wherein the delivery tube is of a size such that, in use, there is a clearance between the fastener and the tube so as to provide a gas cushion around the fastener.
7. Fastener delivery apparatus according to any preceding claim wherein the delivery tube has external orientation and/or location features.
8. Fastener delivery apparatus according to any preceding claim wherein there is provided an additional source of pressurised gas in the sealable passage that serves to clean the rivets of dirt or debris.
9. Fastener delivery apparatus substantially as hereinbefore described with reference to the accompanying drawings.

ABSTRACT

FASTENER DELIVERY APPARATUS

A fastener delivery tube is connected between a supply of fasteners, such as rivets, and the nose of a fastener setting machine. The delivery tube is connected to an outlet tube of a source of compressed air, the outlet tube having an internal bore substantially equal in size to the internal bore of the delivery tube. The supply of fasteners is connected to the delivery tube via a feeder tube and transfer gate. The transfer gate is sealed so as to prevent leakage of air from the delivery tube. The arrangement reduces turbulence in the delivery tube, ensures that friction between the fastener and the tube is reduced and permits compressed air to be supplied at significantly lower pressure than has heretofore been possible.

THIS PAGE BLANK (USPTO)

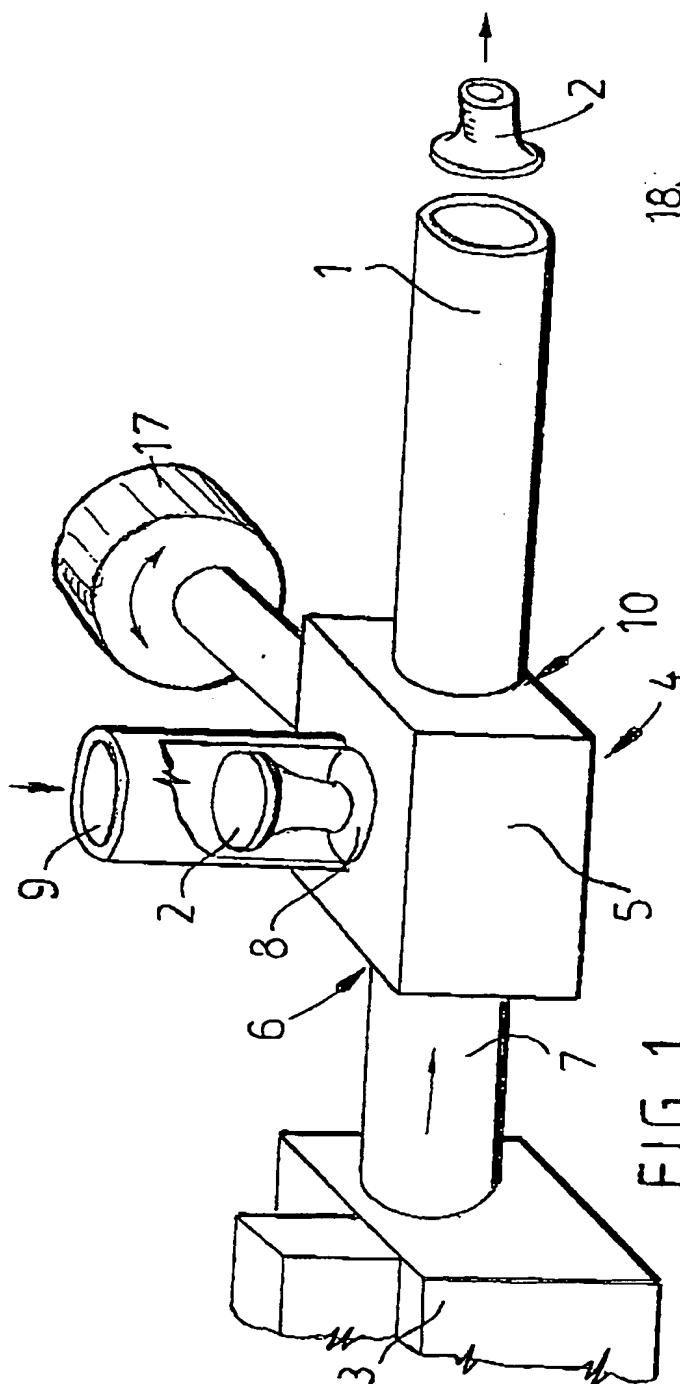


FIG. 1

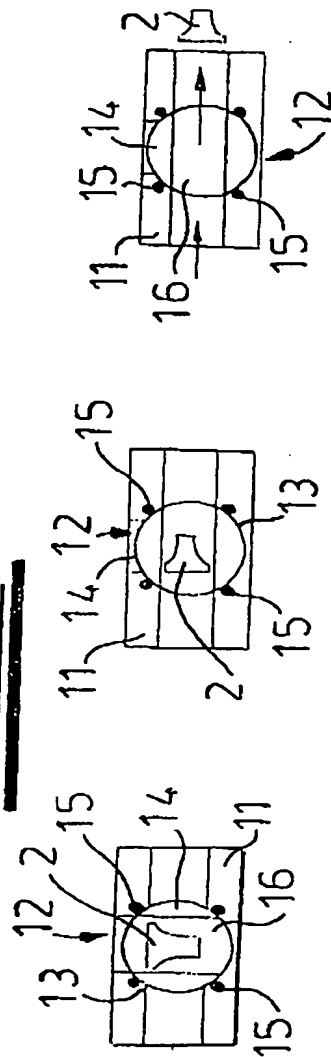


FIG. 2a

FIG. 2b

FIG. 2c

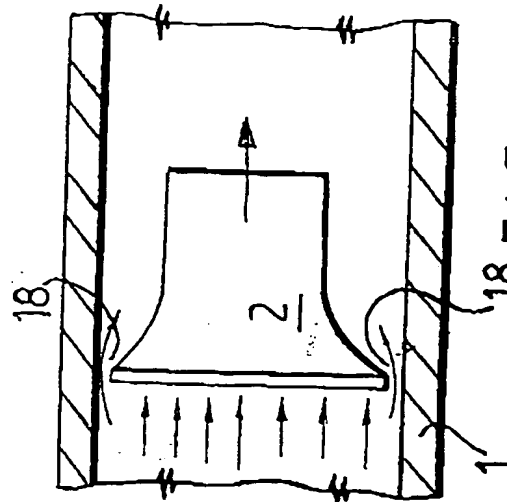
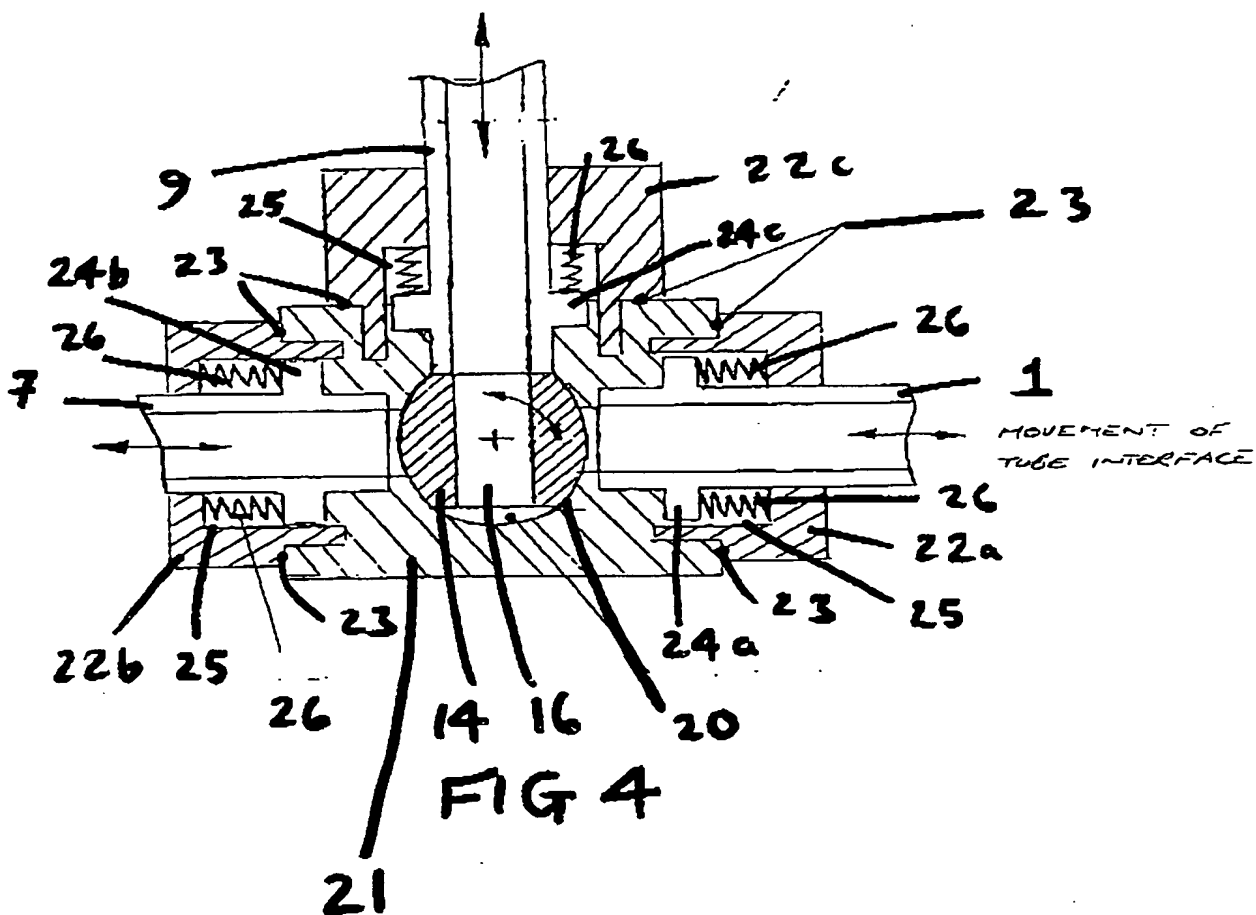


FIG. 3

THIS PAGE BLANK (USPTO)



PCT/SB00/00472

14/2/00 EP

Markis + Clerk

THIS PAGE BLANK (USPTO)